Perioperative perspectives in pilonidal disease - an interdisciplinary dialogue.

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ORIGINAL ARTICLE

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ABSTRACT

We hold a dialogue on perioperative perspectives in pilonidal disease to increase the value of perioperative outcome and patient satisfaction. Our review reveals that patients undergoing more extensive surgeries are better served by general or spinal anesthesia than by minimal approaches employing local anesthesia and the choice should be based on standard anesthesiological considerations such as neuraxial block time or recovery time after general anesthesia rather than the nature of pilonidal disease itself. To ensure sustainable outcome quality, surgeons, together with their anesthesiological partners must consider a wider perspective than the Operating Room and the recovery room, and should include dimensions of the other medical discipline in their decision making. This is best achieved with interprofessional dialogues.

Keywords: surgery, anaesthesia, pilonidal disease.

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INTRODUCTION

Factors such as a pain free postoperative period, short duration of stay in hospital, and early return to work are important, but more than any other measures, a recurrence-free outcome is pivotal for long term satisfaction in pilonidal disease (PSD) patients.[1] Surgeons, as well as anesthesiologists, have to make every effort to decrease the fragmentation of surgical care and to increase both the value of care and patient satisfaction.[2]

Pro-con debates, popular in scientific papers, on conferences and in any aspect of medicine between specialties are probably not always the most constructive way to help a patient. However, as we are about to learn from global realities such as the rapid evolution of the world wide web and the globalized economy, benevolent interprofessional dialogues towards sustainable solutions rather than pro-con debates are a promising way forward.[3]

METHODS

As collaborative acute-care physicians, we, 2 surgeons and 2 anesthesiologist, discussed about what really matters when treating pilonidal disease patients perioperatively so that everyone wins.[2]

DIALOGUE

MML: Andreas and I recently wondered whether it is our subjective impression or reality that we anesthesiologists are more and more confronted with PSD cases. Are we right?

VKS: You are right. For unknown reasons,[4] the incidence of PSD has steadily increased over more than 40 years[5,6] within both military[7,8] and civil cohorts.[9-11] Current data e.g. from Germany show an incidence of 38 per 100,000 with 40,000 surgically treated in-patients every year, which is more than are treated for inguinal hernia in the same age group. [8,12] PSD is frequent in young men, especially in Europe and North America, but is relatively rare in similar Asian and African cohorts. [13]

DD: It might be thought that obese people, people of advanced age, small children, and other cohorts physically unable to cleanse their intergluteal fold, and thus, with decreased personal hygiene, would be at higher risk. However, as we know, neither body mass index (BMI) nor extreme age (> 65 years or < 15 years) are linked with the incidence of PSD. [12,14]

APV: Investigators from other countries report similar findings. [15] What do you surgeons most care about for quality improvement and patient satisfaction?

DD: More than any other measures, a recurrence-free outcome is pivotal for long term satisfaction in PSD patients, although factors such as initial wound closure, a pain free postoperative period, short duration of stay in hospital, early return to work and intradermal, absorbable sutures are also important. [1,16-18] Aesthetic considerations appear to be of importance for some patients.[19]

APV: Which implies specific surgeries?

DD: Yes, as we know, the choice of surgical technique is the most essential decision to ensure recurrence-free course of the disease, thus both marsupialization and median midline closure technique are obsolete, [1] while the long-term role of recently upcoming minimally invasive methods such as pit-picking and sinusectomy remain to be clarified.[20,21]

MML: We might go beyond the choice of surgical technique. I think when aiming to decrease the fragmentation of surgical care, increase the value of care (quality/cost) and increase patient satisfaction,[22] therapeutic success is best achieved through committed interprofessional leadership.[23] I am convinced that anesthesiologists can help to ensure recurrence-free course of the disease.

APV: Agreed. But whereas an extensive body of surgical evidence, including thoroughly elaborated national guidelines, is available, [24] evidence pertaining to anesthesiology is limited, particularly related to performance of these operations in the prone position, let's discuss current perioperative evidence

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applicable to the interdisciplinary mission applying best practices in the treatment of PSD. Usually, young and healthy men are not high-risk cases.

VKS: In the modern era, as you say, PSD patients are often healthy individuals; whereas historically, the proximity to the anus and the septic nature of PSD was connected with a lack of personal hygiene. [25,26] Still, acute pilonidal abscesses are often painful, especially when non-ruptured, and thus considered an emergency case. Incision under local- or cryo-therapy relieves pain within minutes. [27-29]

APV: And then, the patient is healed?

DD: No, but off-midline incision under local- or cryo-therapy is a valuable approach that turns an acute PSD case into an elective operation. [30,31] Chronically fistulating PSD patients without retention are not surgical emergencies. Infiltration with local anesthetics such as a mixture of Carbocain 1% (14 ml) and sodium bicarbonate 5% (6 ml) is also successfully used for definitive treatments such as minimal excision and primary suture. [32]

MML: In 2015 we showed that patient satisfaction correlated with long term, i.e. > 10 years, recurrence-free outcome, and other parameters were of lesser importance. [1] Even though patient specific factors such as BMI and age appear to not affect surgical care of PSD patients, they will be relevant primarily in the context of standard anesthesiological considerations such as airway safety and potential comorbidities.

DD: From our surgical perspective, the best way to treat PSD patients is to employ operative techniques yielding the lowest recurrence rates. Limited excision of PSD with open treatment of the wound is simple to perform and is well tolerated by patients [33] but has recurrence rates of 5-7%[20,33] to > 10%. In some circumstances, the technique is valuable, e.g., when dealing with a septic patient.

VKS: Primary open approaches were the gold standard for a long period. However, the large wounds resulted in lengthy hospital stays. Today, this approach is successfully used in departments with few cases [34] and by experienced surgeons in cases of large tracts not amenable to flap closure. Recurrent disease may be a second reason to choose primary open treatment, if not suitable for a flap procedure. Approaches involving primary midline closure are associated with recurrent disease in up to 50% of cases and should be completely abandoned; thus, we opt for approaches that employ flaps, such as Limberg-, Dufourmentel-, Karydakis-, and Bascom II operations, which have very low recurrence rates (< 5%).

DD: Encouraging results of so called minimal invasive tract excision with trephines have been published by Gips et al.[21], but only reproduced once[35] by Di Castro *et al.* so far. Of practical importance regarding surgeon training, as few as 40-50 procedures are sufficient to reach a professional level of competence for primary closing approaches with flaps. [36]

MML: To increase both the value of care and patient satisfaction it might be worth investing operating room time for surgeons' training to reach a professional level of competence for primary closing approaches with flaps, which result in short hospital stays and low recurrence rates. [36]

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APV: Dietrich and Verena, you often wish to give those flap patients antibiotics. However, I still have not found any specific evidence on preventive antibiotics.

DD: Favoring antibiotics remains relatively vague. The clinical consensus e.g. in Germany is to give patients empirically a single dose in cases where the surgeon opts for an operative technique with primary wound closure. [37] In cases involving primary open approaches, antibiotics are only needed in case of extensive soft tissue infections.[37-39] Local gentamycin application in flap techniques is used more and more frequently to reducing flap infection[40,41] rate but specific evidence is lacking.

VKS: Two RCTs on antibiotic prophylaxis for Karydakis flap were stopped early due to increased rates of wound infection.[42,43] Is there more specific evidence for anesthesia techniques?

APV: Historically, spinal anesthesia was established decades ago as the gold standard for PSD operations.[44] Some side effects such as post puncture headache appear to be more rare in prone position.[45] In a randomized clinical trial in 50 PSD patients, Schmittner et al compared surgeries performed under spinal anesthesia and surgeries performed under total intravenous anesthesia; they reported a significantly shorter monitoring times in the recovery room after spinal anesthesia. Unsurprisingly, these patients also were able to drink and eat significantly earlier, had less sore throat, and needed less analgesia in the recovery room. However, both groups were satisfied with the anesthesia provided, despite more cases of postoperative nausea and vomiting among patients receiving total intravenous anesthesia. The authors concluded that spinal anesthesia was superior to total intravenous anesthesia for PSD patients. [46]

MML: Nonetheless, in long term follow up, we recently showed that post-operative pain scores were not significantly different between spinal and general anesthesia. [47]

DD: Also, we showed that recurrence rates were not significantly different between the two anesthetic approaches [47].

APV: In a randomized setting including 180 patients undergoing anorectal surgery, Ariyama et al studied the effect of baricity and positioning on the spread of spinal anesthesia (0.5% bupivacaine) in prone (jackknife) position. They found that sitting time before final positioning—rather than baricity— was the more significant factor affecting the cephalad spreading of spinal anesthesia. [48]

MML: Selective sensory blocks using low doses of plain solutions of bupivacaine or levobupivacaine have been shown to be equally effective for inducing spinal anesthesia for PSD surgeries in prone position.[49] Concentrations as low as 0.1% bupivacaine were described.[50] Increased hemodynamic stability and perioperative patient satisfaction are the major advantages of selective sensory blocks.[51]

VKS: But transient neurologic symptoms were described in patients receiving spinal anesthesia with hypobaric 2% [52] and 3% [53] lidocaine in prone position. Low incidences (0.4%) of transient neurologic symptoms were reported for low dose hyperbaric lidocaine administered for surgeries in prone position; however, spinal anesthesia was administered to patients in this cohort in the right lateral decubitus position before being placed prone. [54]

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MML: You are right. Nonetheless, the cause of transient neurologic symptoms remains uncertain; in addition to receiving spinal anesthesia in prone position, the positioning of the patient for and during surgery may contribute to this complication. [52]

APV: An interesting alternative is the use of epidural anesthesia as another neuraxial technique for surgeries in PSD patients, e.g., to move the location of injection cranially away from the infection. A Korean group studying epidural anesthesia with both levobupivacaine and ropivacaine in PSD patients recently reported rapid onset of analgesia with no motor blocks but sensorial block durations of 297 and 332 minutes, respectively.[55]

MML: But keep in mind, as is true for other established absolute contraindications, such as severe aortic valve stenosis or local infections, the presence of lumbar osteomyelitis in PSD patients is a contraindication for both spinal and epidural anesthesia. [56]

DD: Then you opt for general anesthesia?

MML: Yes. Induction of anesthesia and endotracheal intubation in supine position is the gold standard of perioperative care for surgeries performed in both supine and prone positions. The indications for endotracheal intubation, such as gastroesophageal reflux, are independent of any specific component of PSD surgery as are established predictors of difficult intubation such as local tumors, trauma, macroglossia, beards, higher BMI, and higher Mallampati grade. Airway algorithms for both unanticipated and anticipated difficult airway intubation stress the safety of fiber optic intubation of awake patients in supine position. [57-59]

DD: How about laryngeal masks?

APV: To date, no official guidelines for the use of laryngeal masks in prone position exist. Evidence is limited to individual studies. In a prospective study of 50 ASA 1 and 2 patients undergoing surgery in the prone position, patients either received general anesthesia induction and airway management via laryngeal mask insertion after being positioned awake in prone position, or were anesthetized and intubated in standard fashion in supine position before being turned to prone position. The incidence of complications such as airway loss were similar between the groups.

MML: However, intubation and positioning in the laryngeal mask procedure was significantly shorter and required significantly less man power than the standard procedure. Additionally, this group was hemodynamically significantly more stable during the surgery. [60] Additional studies confirmed these findings with different supraglottic airway devices, and showed that some devices appeared to be more favorable with respect to the number of manipulations needed, the establishment of viewing the vocal cords with fiber optics, or the achievement of specific seal pressures. [61] Similar studies have confirmed the efficiency, safety and reduced incidence of postoperative sore throat associated with this approach, [62] but also warned to the potential for soft tissue trauma, [63] and emphasized that experience with the technique is important for providing safe anesthesia. [64]

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VKS: How else do you ensure perioperative quality?

APV: Not having to administer neuromuscular blocking agents clearly favors laryngeal masks for airway management in general anesthesia for ambulatory pilonidal disease surgery. Yet, irrespective of the kind of anesthesia or primary establishment of airway, the laryngeal mask as a support for fiber optic tracheal intubation has been an essential component of difficult airway algorithms provided by the ASA for more than 20 years. The advent of laryngeal masks markedly reduced the numbers of "cannot ventilate, cannot intubate" situations. [58,65]

MML: Another "game changer" such as the laryngeal mask is near-infrared spectroscopy (NIRS), a technique to measure oxygen saturation of hemoglobin in the microcirculation (venous and arterial). [7] Broadly speaking, it be used to assess oxygenation and vascular function in the forebrain (cerebral NIRS) or in the peripheral tissues (Peripheral NIRS). Our orthopedic colleagues more and more often ask us to employ NIRS during some of their orthopedic surgeries. [66] I wonder, what you think of NIRS for surgeries in prone position – would that increase quality?

DD: Using NIRS, Babakhani et al examined a case series of 50 patients with general anesthesia in prone position for spine surgery. Their analysis uncovered bilateral regional cerebral oxygen desaturation 30 and 60 minutes after positioning to prone. However, the observed decreases were <10%, leaving a satisfactory margin of safety. I don't think I will ask you for NIRS in my PSD patients in the near future

VKS: I might do so in the rare cases of advanced age and higher perioperative risk since these factors were identified as risk factors for cerebral desaturation in prone position; whereas, as was known, the prevention of bradycardia and hypotension were found to be protective. [67] Yet, what has to be done if NIRS shows reduced cerebral oxygenation?

MML: If NIRS values decrease intraoperatively, hemodynamics has to be evaluated immediately. If no obvious reversible reason is recognized, the patient has to be evaluated neurologically as soon as possible. Beyond cerebral oxygen desaturation, complications of prone position under general anesthesia include extrinsic tracheal compression, [68] sensorineural hearing loss, [69]and increased intraocular pressure. [70] However, complications such as orbital compartment syndrome, [71] blindness, and cavernous sinus thrombosis are rare. Some complications may be attributable to improper positioning in the headrest.[72]

APV: Vigilance is required to prevent such complications, since visual loss has also been reported in patients placed prone in modern (disposable) soft foam headrests.[73] There is no convincing evidence whether or not a mirror helps to prevent respective complications. Also remember to applying pillows under the patient's chest and pelvis and to leaving the abdomen as free as possible and to position of upper limbs with attentive caution. When placing the ECG dots, remember the patient's mirrored sides in prone position. Better just operating under local anesthesia without spinal or general anesthesia at all?

VKS: Some studies of PSD surgery under (tumescent) local anesthesia in small cohorts report shorter recovery time and lower postoperative pain scores with earlier discharge within "minutes after the operation",[74] earlier return to work,[20] and without any increase in complication rates. [27-29,75] Also in a small

cohort, a decrease in length of stay is reported when combining local anesthesia with midazolam for additional sedation [76] or phenol application as a local treatment add-on. [77]

DD: Well, on the downside, phenol application as a treatment strategy is associated with higher recurrence rates, [77] and can only be recommended as an low-cost measure to convert a chronic fistulating PSD into fibrotic scarring. [30] Alternatively, administration of phenol into the PSD cavity has been described as an effective strategy for potentially emergent situations. [31] However, although at a first glance cryo- or local anesthesia may appear to be favorable, each of these has been associated with higher recurrence rates in PSD patients,[47] probably due to insufficient excisions irrespective of phenol treatment.

MML: Today we know that recurrence heavily depends on follow-up time but also on the type of surgery. Some surgeons report good results for specific, minimally invasive procedures[32,78,79]
APV:Additionally, radical excision of complicated tract systems may be better done under spinal or general anesthesia due to other ways needing, potentially toxic high doses of local anesthetics.

DD: As far as we know, the number of sinuses at skin level has no predictive value about the underlying size and extent of the tract system. [80] Do you prefer spinal or general anesthesia when considering the postoperative course?

APV: In a small cohort study, it was reported that postoperative pain was lower after spinal than after total intravenous anesthesia. [46] Adding 12.5-25 µg Fentanyl to a spinal anesthesia additionally improves analgesic quality. [81] Additionally, as would be expected, spinal anesthesia was associated with decreased incidences of side effects such as postoperative nausea and vomiting and sore throat compared to total intravenous anesthesia in a study of 50 patients in the recovery room. [46]

VKS: Both magnesium sulfate and dexamethasone have been reported to decrease postoperative sore throat after surgeries under general anesthesia in prone position. [82]

DD: Yet, to ensure sustainable outcome quality, anesthesiologists must consider a wider perspective, the perioperative surgical home,[83] and need to include surgical dimensions in their decision making. [3] As we know from a large German cohort, patient satisfaction depends on long term recurrence-free outcome. [1]

MML: Whereas, postoperative pain, [47] surgical treatment, and duration of in-hospital stay is of lower importance for patient satisfaction. [1]

DD: However, some evidence suggests that recurrence rates are higher when the procedure is performed under local anesthesia, and patients are better served by well-trained surgeons and well executed surgeries under general or spinal anesthesia. Thus, the approach in anesthesia should be correlated to the complexity of the surgery.

APV: The currently available evidence suggests that the choice between neuraxial and general anesthesia should be based on standard anesthesiological considerations such as neuraxial block time or recovery time after general anesthesia rather than the nature of PSD itself [47] when aiming to decrease the

fragmentation of surgical care, increase the value of care (quality/cost) and increase patient satisfaction[83] in pilonidal disease surgery.

CONCLUSION

More than any other metric, recurrence-free outcome is known to be pivotal for long term satisfaction in PSD patients, and the surgical technique is the most essential decision to ensure recurrence-free course of the disease. Factors such as pain free postoperative period, short duration of stay in hospital, and early return to work are secondary. Thus, therapeutic success is best reached by committed interprofessional leadership and collaboration.

Patient specific factors such as BMI and age do not affect perioperative care of PSD patients, and they are relevant only in the context of standard anesthesiological considerations such as airway safety and potential comorbidities. Off-midline drainage of a painful acute pilonidal abscess under local anesthesia turns this into an elective condition.

Investing in both longer theater times to accommodate more sophisticated surgeries such as flap techniques, and investing in surgical training to learn these techniques, would to be reasonable since recurrence free outcome is pivotal for patient satisfaction.

Spinal anesthesia is the historical gold standard for PSD operations. Patients receiving spinal anesthesia have shorter monitoring times and lower pain scores in the recovery room. The use of low doses of plain solutions for induction of spinal anesthesia with only sensory blocks and prone position for PSD surgeries provide increased hemodynamic stability, improved perioperative patient satisfaction, and shorter recovery time.

Induction of anesthesia and endotracheal intubation in supine position is the gold standard for surgeries performed in prone position. Some evidence suggests that the use of laryngeal masks in prone position is feasible but has to be considered as not routine practice. Not having to administer neuromuscular blocking agents clearly favor laryngeal masks for airway management in general anesthesia for ambulatory pilonidal disease surgery. Irrespective of the kind of anesthesia or primary establishment of airway, the laryngeal mask as support for fiber optic tracheal intubation is an essential component of difficult airway algorithms.

Cryo- or local anesthesia for PSD abscess incision enables shorter recovery times and is associated with lower postoperative pain scores. These strategies are not feasible for extensive surgeries but for low-invasive approaches such as deroofing or pit picking. Additionally, these strategies are used to reduce acute pain and turn an acute PSD abscess into an elective case.

To ensure sustainable outcome quality, surgeons, together with their anesthesiological partners must consider a perspective wider than the OR and recovery room, and should include dimensions of the other specialty in their decision making.

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REFERENCES

1. Doll D, Luedi MM, Evers T, Kauf P, Matevossian E. Recurrence-free survival, but not surgical therapy per se, determines 583 patients' long-term satisfaction following primary pilonidal sinus surgery. *International journal of colorectal disease* 2015; 30(5): 605-11.
2. Vetter TR, Goeddel LA, Boudreaux AM, Hunt TR, Jones KA, Pittet JF. The Perioperative Surgical Home: how can it make the case so everyone wins? *BMC anesthesiology* 2013; 13: 6.
3. Luedi MM, Doll D. In Dialogue. *Anesth Analg* 2016; 123(5): 1339-40.
4. Allen-Mersh TG. Pilonidal sinus: finding the right track for treatment. *The British journal of surgery* 1990; 77(2): 123-32.
5. Karydakis GE. New approach to the problem of pilonidal sinus. *Lancet* 1973; 2(7843): 1414-5.
6. Karydakis GE. Easy and successful treatment of pilonidal sinus after explanation of its causative process. *Aust N Z J Surg* 1992; 62(5): 385-9.
7. Akinci OF, Bozer M, Uzunköy A, Düzgün SA, Coskun A. Incidence and aetiological factors in pilonidal sinus among Turkish soldiers. *EurJ Surg* 1999; 165(4): 339-42.
8. Evers T, Doll D, Matevossian E, Noe S, Neumann K, Li HL, Huser N, Ludde R, Hoffmann S, Krapohl BD. [Trends in incidence and long-term recurrence rate of pilonidal sinus disease and analysis of associated influencing factors]. *Zhonghua wai ke za zhi [Chinese journal of surgery]* 2011; 49(9): 799-803.
9. Duman K, Girgin M, Harlak A. Prevalence of sacrococcygeal pilonidal disease in Turkey. *Asian J Surg* 2016.
10. Karahan Ö, Eryilmaz MA, Torun V, Sevinç B, Köksal H, Aksoy F, Ay S. Is the increase in the number of pilonidal sinus surgery normal? *Turk J Surg* 2010; 26(4): 207-11.

Cite this Article as: Verena K. Stauffer, Markus M. Luedi, Andreas P. Vogt, Dietrich Doll. Perioperative perspectives in pilonidal disease - an interdisciplinary dialogue. PSJ 2017;(3)1: 32-47.

11. Doll D, Luedi MM, Wieferich K, van der Zypen D, Maak M, Glanemann M. Stop insulting the patient: neither incidence nor recurrence in pilonidal sinus disease is linked to personal hygiene. *Pilonidal Sinus Journal* 2015; 1(1): 11-9.

12. Doll DH, Luedi MM, Wieferich K, van der Zypen D, Maak M, Glanemann M. Stop insulting the patient: neither incidence nor recurrence in pilonidal sinus disease is linked to personal hygiene. *Pilonidal Sinus Journal* 2015; 1(1): 8.

13. Chijiwa T, Suganuma T, Takigawa T, Edogawa S, Inoue K, Yanagida S, Hatada J. Pilonidal sinus in Japan maritime self-defense force at Yokosuka. *Mil Med* 2006; 171(7): 650-2.

14. Favre R, Delacroix P. [Apropos of 1,110 Cases of Pilonidal Disease of Coccy-Perineal Localization]. *Mem Acad Chir (Paris)* 1964; 90: 669-76.

15. Karahan Ö, Eryılmaz MA, Torun V, Sevinç B, Köksal H, Aksoy F, Ay S. Pilonidal sinüs ameliyatlarındaki artış normal mi? *Ulusal Cerrahi Dergisi* 2010; 26(4): 207-11.

16. Ertan T, Koc M, Gocmen E, Aslar AK, Keskek M, Kilic M. Does technique alter quality of life after pilonidal sinus surgery? *Am J Surg* 2005; 190(3): 388-92.

17. Gaiser MR, Lee SB, Enk A, Schrott P, Weisser H. Surgical intervention of pilonidal sinus: impact on patients' postoperative satisfaction and return to work time. *European journal of dermatology : EJD* 2013; 23(4): 487-90.

18. Milone M, Musella M, Maietta P, Bianco P, Taffuri C, Salvatore G, Milone F. Intradermal absorbable sutures to close pilonidal sinus wounds: a safe closure method? *Surg Today* 2014; 44(9): 1638-42.

19. Müller K, Marti L, Tarantino I, Jayne DG, Wolff K, Hetzer FH. Prospective analysis of cosmesis, morbidity, and patient satisfaction following Limberg flap for the treatment of sacrococcygeal pilonidal sinus. *Dis Colon Rectum* 2011; 54(4): 487-94.

20. Soll C, Dindo D, Steinemann D, Hauffe T, Clavien PA, Hahnloser D. Sinusectomy for primary pilonidal sinus: less is more. *Surgery* 2012; 150(5): 996-1001.

21. Gips M, Melki Y, Salem L, Weil R, Sulkes J. Minimal surgery for pilonidal disease using trephines: description of a new technique and long-term outcomes in 1,358 patients. *Dis Colon Rectum* 2008; 51(11): 1656-62.

22. Vetter TR, Boudreaux AM, Jones KA, Hunter JM, Jr., Pittet JF. The perioperative surgical home: how anesthesiology can collaboratively achieve and leverage the triple aim in health care. *Anesthesia and analgesia* 2014; 118(5): 1131-6.

Cite this Article as: Verena K. Stauffer, Markus M. Luedi, Andreas P. Vogt, Dietrich Doll. Perioperative perspectives in pilonidal disease - an interdisciplinary dialogue. PSJ 2017;(3)1: 32-47.

23. Luedi MM, Doll D, Boggs S, Stueber F. Successful personalities in anesthesiology and acute care medicine - are we selecting, training, and supporting the best? *Anesthesia and analgesia* In Press.

24. Iesalnieks I, Ommer A, Petersen S, Doll D, Herold A. German national guideline on the management of pilonidal disease. *Langenbeck's archives of surgery / Deutsche Gesellschaft fur Chirurgie* 2016; 401(5): 599-609.

25. Conroy FJ, Kandamany N, Mahaffey PJ. Laser depilation and hygiene: preventing recurrent pilonidal sinus disease. *Journal of plastic, reconstructive & aesthetic surgery : JPRAS* 2008; 61(9): 1069-72.

26. Kandamany N, Mahaffey PJ. The importance of hair control and personal hygiene in preventing recurrent pilonidal sinus disease. *Journal of plastic, reconstructive & aesthetic surgery : JPRAS* 2008; 61(8): 986-7.

27. Rahmani N, Gholipour Baradari A, Heydari Yazdi SM, Firouzian A, Hashemi SA, Fazli M, Sadeghian I. Pilonidal Sinus Operations Performed Under Local Anesthesia versus the General Anesthesia: Clinical Trial Study. *Glob J Health Sci* 2016; 8(9): 53531.

28. Yalcin S, Ergul E. A single-surgeon, single-institute experience of 59 sinotomies for sacrococcygeal pilonidal disease under local anesthesia. *Bratisl Lek Listy* 2010; 111(5): 284-5.

29. Kayaalp C, Olmez A, Aydin C, Piskin T. Tumescent local anesthesia for excision and flap procedures in treatment of pilonidal disease. *Dis Colon Rectum* 2009; 52(10): 1780-3.

30. Hussain ZI, Aghahoseini A, Alexander D. Converting emergency pilonidal abscess into an elective procedure. *Dis Colon Rectum* 2012; 55(6): 640-5.

31. Khalil PN, Brand D, Siebeck M, Hallfeldt K, Mutschler W, Kanz KG. Aspiration and injection-based technique for incision and drainage of a sacrococcygeal pilonidal abscess. *J Emerg Med* 2009; 36(1): 60-3.

32. Khodakaram K, Stark J, Hoglund I, Andersson RE. Minimal Excision and Primary Suture is a Cost-Efficient Definitive Treatment for Pilonidal Disease with Low Morbidity: A Population-Based Interventional and a Cross-Sectional Cohort Study. *World journal of surgery* 2017; 41(5): 1295-302.

33. Soll C, Hahnloser D, Dindo D, Clavien PA, Hetzer F. A novel approach for treatment of sacrococcygeal pilonidal sinus: less is more. *Int J Colorectal Dis* 2008; 23(2): 177-80.

34. Fabricius R, Petersen LW, Bertelsen CA. Treatment of pilonidal sinuses in Denmark is not optimal. *therapiespektrum nora* 2010; 57(12): A4200.

Cite this Article as: Verena K. Stauffer, Markus M. Luedi, Andreas P. Vogt, Dietrich Doll. Perioperative perspectives in pilonidal disease - an interdisciplinary dialogue. PSJ 2017;(3)1: 32-47.

35. Di Castro A, Guerra F, Sandri GB, Maria Ettorre G. Minimally invasive surgery for the treatment of pilonidal disease. The Gips procedure on 2347 patients. *Int J Surg* 2016.

36. Wysocki AP. Defining the learning curve for the modified Karydakis flap. *Tech Coloproctol* 2015; 19(12): 753-5.

37. Ommer A, Berg E, Breitkopf C, Bussen D, Doll D, Fürst A, Herold A, Hetzer F, Jacobi T, Krammer H. S3-Leitlinie: Sinus pilonidalis. *coloproctology* 2014; 36(4): 272-322.

38. Ozbalci GS, Tuncal S, Bayraktar K, Tasova V, Ali Akkus M. Is gentamicin-impregnated collagen sponge to be recommended in pilonidal sinus patient treated with marsupialization? A prospective randomized study. *Ann Ital Chir* 2014; 85: 576-82.

39. Şeker D, Uğurlu C, Ergül Z, Akinci M, Ölçücüoğlu E, Kulaçoğlu H. Single dose prophylactic antibiotics may not be sufficient in elective pilonidal sinus surgery: An early terminated study. *Turk Klinikleri J Med Sci* 2011; 31(1): 186-90.

40. Brückner B, Volmerig J. Zur Wirksamkeit von Sulmycin-Implantat bei der geschlossenen Behandlung des Sinus pilonidalis. *Wehrmedizinische Monatsschrift* 1997; 41: 141-5.

41. Chang WK, Srinivasa S, MacCormick AD, Hill AG. Gentamicin-collagen implants to reduce surgical site infection: Systematic review and meta-analysis of randomized trials. 2013; 258(1): 59-65.

42. Karip AB, Celik K, Aydin T, Yazicilar H, Iscan Y, Agalar C, Memisoglu K. Effect of Triclosan-Coated Suture and Antibiotic Prophylaxis on Infection and Recurrence after Karydakis Flap Repair for Pilonidal Disease: A Randomized Parallel-Arm Double-Blinded Clinical Trial. *Surg Infect (Larchmt)* 2016; 17(5): 583-8.

43. ŞEKER D, UĞURLU C, ERGÜL Z, Akinci M, ÖLÇÜCÜOĞLU E, KULAÇOĞLU H. Single dose prophylactic antibiotics may not be sufficient in elective pilonidal sinus surgery: An early terminated study. *Turk Klinikleri J Med Sci* 2011; 31(1): 186-90.

44. Theis F, Rusher M. The pilonidal sinus: sacrococcygeal cyst teratoma. *The Journal of the American Society of Anesthesiologists* 1945; 6(4): 448-.

45. Dogan M, Turker H, Ugurlu M, Ergun F, Bozkurt M. Do peroperative supine and prone positions have an effect on postspinal headache incidence? *Neurosciences (Riyadh, Saudi Arabia)* 2005; 10(1): 64-7.

46. Schmittner MD, Dieterich S, Gebhardt V, Weiss C, Burmeister MA, Bussen DG, Viergutz T. Randomised clinical trial of pilonidal sinus operations performed in the prone position under spinal anaesthesia with hyperbaric bupivacaine 0.5 % versus total intravenous anaesthesia. *International journal of colorectal disease* 2013; 28(6): 873-80.

Cite this Article as: Verena K. Stauffer, Markus M. Luedi, Andreas P. Vogt, Dietrich Doll. Perioperative perspectives in pilonidal disease - an interdisciplinary dialogue. PSJ 2017;(3)1: 32-47.

47. Luedi MM, Kauf P, Evers T, Sievert H, Doll D. Impact of spinal versus general anesthesia on postoperative pain and long term recurrence after surgery for pilonidal disease. *Journal of clinical anesthesia* 2016; 33: 236-42.

48. Ariyama J, Hayashida M, Sugimoto Y, Imanishi H, To-Oyma Y, Kitamura A. Spread of spinal anesthesia in patients having perianal surgery in the jackknife position: effects of baricity of 0.5% bupivacaine and positioning during and after induction of spinal anesthesia. *Journal of clinical anesthesia* 2009; 21(6): 408-13.

49. Cuvas O, Gulec H, Karaaslan M, Basar H. The use of low dose plain solutions of local anaesthetic agents for spinal anaesthesia in the prone position: bupivacaine compared with levobupivacaine. *Anaesthesia* 2009; 64(1): 14–8.

50. Maroof M, Khan RM, Siddique M, Tariq M. Hypobaric spinal anaesthesia with bupivacaine (0.1%) gives selective sensory block for ano-rectal surgery. *Canadian journal of anaesthesia = Journal canadien d'anesthesie* 1995; 42(8): 691-4.

51. Imbelloni LE, Gouveia MA, Vieira EM, Cordeiro JA. Selective sensory spinal anaesthesia with hypobaric lidocaine for anorectal surgery. *Acta anaesthesiologica Scandinavica* 2008; 52(10): 1327-30.

52. Alley EA, Pollock JE. Transient neurologic syndrome in a patient receiving hypobaric lidocaine in the prone jack-knife position. *Anesthesia and analgesia* 2002; 95(3): 757-9.

53. Morisaki H, Masuda J, Kaneko S, Matsushima M, Takeda J. Transient neurologic syndrome in one thousand forty-five patients after 3% lidocaine spinal anesthesia. *Anesthesia and analgesia* 1998; 86(5): 1023-6.

54. Pollock JE, Neal JM, Stephenson CA, Wiley CE. Prospective study of the incidence of transient radicular irritation in patients undergoing spinal anesthesia. *Anesthesiology* 1996; 84(6): 1361-7.

55. Orhon ZN, Koltka EN, Devrim S, Tufekci S, Dogru S, Celik M. Epidural anesthesia for pilonidal sinus surgery: ropivacaine versus levobupivacaine. *Korean J Anesthesiol* 2015; 68(2): 141-7.

56. Verdu A, Garcia-Granero E, Garcia-Fuster MJ, Martin A, Millan M, Lledo S. Lumbar osteomyelitis and epidural abscess complicating recurrent pilonidal cyst: report of a case. *Dis Colon Rectum* 2000; 43(7): 1015-7.

57. Hagberg CA, Gabel JC, Connis RT. Difficult Airway Society 2015 guidelines for the management of unanticipated difficult intubation in adults: not just another algorithm. *British journal of anaesthesia* 2015; 115(6): 812-4.

Cite this Article as: Verena K. Stauffer, Markus M. Luedi, Andreas P. Vogt, Dietrich Doll. Perioperative perspectives in pilonidal disease - an interdisciplinary dialogue. PSJ 2017;(3)1: 32-47.

58. Benumof JL. Laryngeal mask airway and the ASA difficult airway algorithm. *Anesthesiology* 1996; 84(3): 686-99.

59. Frerk C, Mitchell VS, McNarry AF, Mendonca C, Bhagrath R, Patel A, O'Sullivan EP, Woodall NM, Ahmad I. Difficult Airway Society 2015 guidelines for management of unanticipated difficult intubation in adults. *British journal of anaesthesia* 2015; 115(6): 827-48.

60. Weksler N, Klein M, Rozentsveig V, Weksler D, Sidelnik C, Lottan M, Gurman GM. Laryngeal mask in prone position: pure exhibitionism or a valid technique. *Minerva anestesiologica* 2007; 73(1-2): 33-7.

61. Lopez AM, Valero R, Hurtado P, Gambus P, Pons M, Anglada T. Comparison of the LMA Supreme with the LMA Proseal for airway management in patients anaesthetized in prone position. *British journal of anaesthesia* 2011; 107(2): 265-71.

62. Olsen KS, Petersen JT, Pedersen NA, Rovsing L. Self-positioning followed by induction of anaesthesia and insertion of a laryngeal mask airway versus endotracheal intubation and subsequent positioning for spinal surgery in the prone position: a randomised clinical trial. *European journal of anaesthesiology* 2014; 31(5): 259-65.

63. Ng A, Raitt DG, Smith G. Induction of anesthesia and insertion of a laryngeal mask airway in the prone position for minor surgery. *Anesthesia and analgesia* 2002; 94(5): 1194-8.

64. Brimacombe JR, Wenzel V, Keller C. The proseal laryngeal mask airway in prone patients: a retrospective audit of 245 patients. *Anaesthesia and intensive care* 2007; 35(2): 222-5.

65. Kramer DC, Lo JC, Gilad R, Jenkins A, 3rd. Fiberoptic scope as a rescue device in an anesthetized patient in the prone position. *Anesthesia and analgesia* 2007; 105(3): 890.

66. Luedi MM, Bendjelid K. Hemodynamic monitoring during surgeries in beach chair position: What can a big picture teach us? *Journal of clinical monitoring and computing* 2016.

67. Babakhani B, Heroabadi A, Hosseinitabatabaei N, Schott M, Yekaninejad S, Jantzen JP, Baumert JH. Cerebral Oxygenation Under General Anesthesia Can Be Safely Preserved in Patients Prone Position: A Prospective Observational Study. *Journal of neurosurgical anesthesiology* 2016.

68. Choi RM, Yoon JS, Noh JH, Kang KO, Ryu SW, Jun HJ, Cho SS. Airway obstruction by extrinsic tracheal compression during spinal surgery under prone position -A case report. *Korean journal of anesthesiology* 2010; 59 Suppl: S45-8.

Cite this Article as: Verena K. Stauffer, Markus M. Luedi, Andreas P. Vogt, Dietrich Doll. Perioperative perspectives in pilonidal disease - an interdisciplinary dialogue. PSJ 2017;(3)1: 32-47.

69. Mak PH, Tumber PS. Postoperative sudden sensorineural hearing loss after posterior lumbar decompression: a case report. *Canadian journal of anaesthesia = Journal canadien d'anesthesie* 2003; 50(5): 519-21.

70. Hunt K, Bajekal R, Calder I, Meacher R, Eliahoo J, Acheson JF. Changes in intraocular pressure in anesthetized prone patients. *Journal of neurosurgical anesthesiology* 2004; 16(4): 287-90.

71. Leibovitch I, Casson R, Laforest C, Selva D. Ischemic orbital compartment syndrome as a complication of spinal surgery in the prone position. *Ophthalmology* 2006; 113(1): 105-8.

72. Anand S, Mushin AS. Cavernous sinus thrombosis following prone position anaesthesia. *Eye (London, England)* 2005; 19(7): 803-4.

73. Roth S, Tung A, Ksiazek S. Visual loss in a prone-positioned spine surgery patient with the head on a foam headrest and goggles covering the eyes: an old complication with a new mechanism. *Anesthesia and analgesia* 2007; 104(5): 1185-7.

74. Bertelsen CA. Cleft-lift operation for pilonidal sinuses under tumescent local anesthesia: a prospective cohort study of peri- and postoperative pain. *Dis Colon Rectum* 2011; 54(7): 895-900.

75. Naja MZ, Ziade MF, El Rajab M. Sacrococcygeal local anaesthesia versus general anaesthesia for pilonidal sinus surgery: a prospective randomised trial. *Anaesthesia* 2003; 58(10): 1007-12.

76. Sungurtekin H, Sungurtekin U, Erdem E. Local anesthesia and midazolam versus spinal anesthesia in ambulatory pilonidal surgery. *J Clin Anesth* 2003; 15(3): 201-5.

77. Bayhan Z, Zeren S, Duzgun SA, Ucar BI, Alparslan Yumun HN, Mestan M. Crystallized phenol application and modified Limberg flap procedure in treatment of pilonidal sinus disease: A comparative retrospective study. *Asian J Surg* 2016; 39(3): 172-7.

78. Garg P, Menon GR, Gupta V. Laying open (deroofing) and curettage of sinus as treatment of pilonidal disease: a systematic review and meta-analysis. *ANZ journal of surgery* 2016; 86(1-2): 27-33.

79. Garg P, Garg M, Gupta V, Mehta SK, Lakhtaria P. Laying open (deroofing) and curettage under local anesthesia for pilonidal disease: An outpatient procedure. *World journal of gastrointestinal surgery* 2015; 7(9): 214-8.

Cite this Article as: Verena K. Stauffer, Markus M. Luedi, Andreas P. Vogt, Dietrich Doll. Perioperative perspectives in pilonidal disease - an interdisciplinary dialogue. PSJ 2017;(3)1: 32-47.

80. Doll D, Novotny A, Wietelmann K, Matevossian E, Evers T, Lieber A, Düsel W, Petersen S. Factors influencing surgical decisions in chronic pilonidal sinus disease. *European Surgery* 2009; 41(2): 60-5.

81. Honca M, Dereli N, Kose EA, Honca T, Kutuk S, Unal SS, Horasanli E. Low-dose levobupivacaine plus fentanyl combination for spinal anesthesia in anorectal surgery. *Brazilian journal of anesthesiology (Elsevier)* 2015; 65(6): 461-5.

82. Park JH, Shim JK, Song JW, Jang J, Kim JH, Kwak YL. A Randomized, Double-blind, Non-inferiority Trial of Magnesium Sulphate versus Dexamethasone for Prevention of Postoperative Sore Throat after Lumbar Spinal Surgery in the Prone Position. *International journal of medical sciences* 2015; 12(10): 797-804.

83. Vetter TR, Barman J, Hunter JM, Jr., Jones KA, Pittet JF. The Effect of Implementation of Preoperative and Postoperative Care Elements of a Perioperative Surgical Home Model on Outcomes in Patients Undergoing Hip Arthroplasty or Knee Arthroplasty. *Anesthesia and analgesia* 2016.

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